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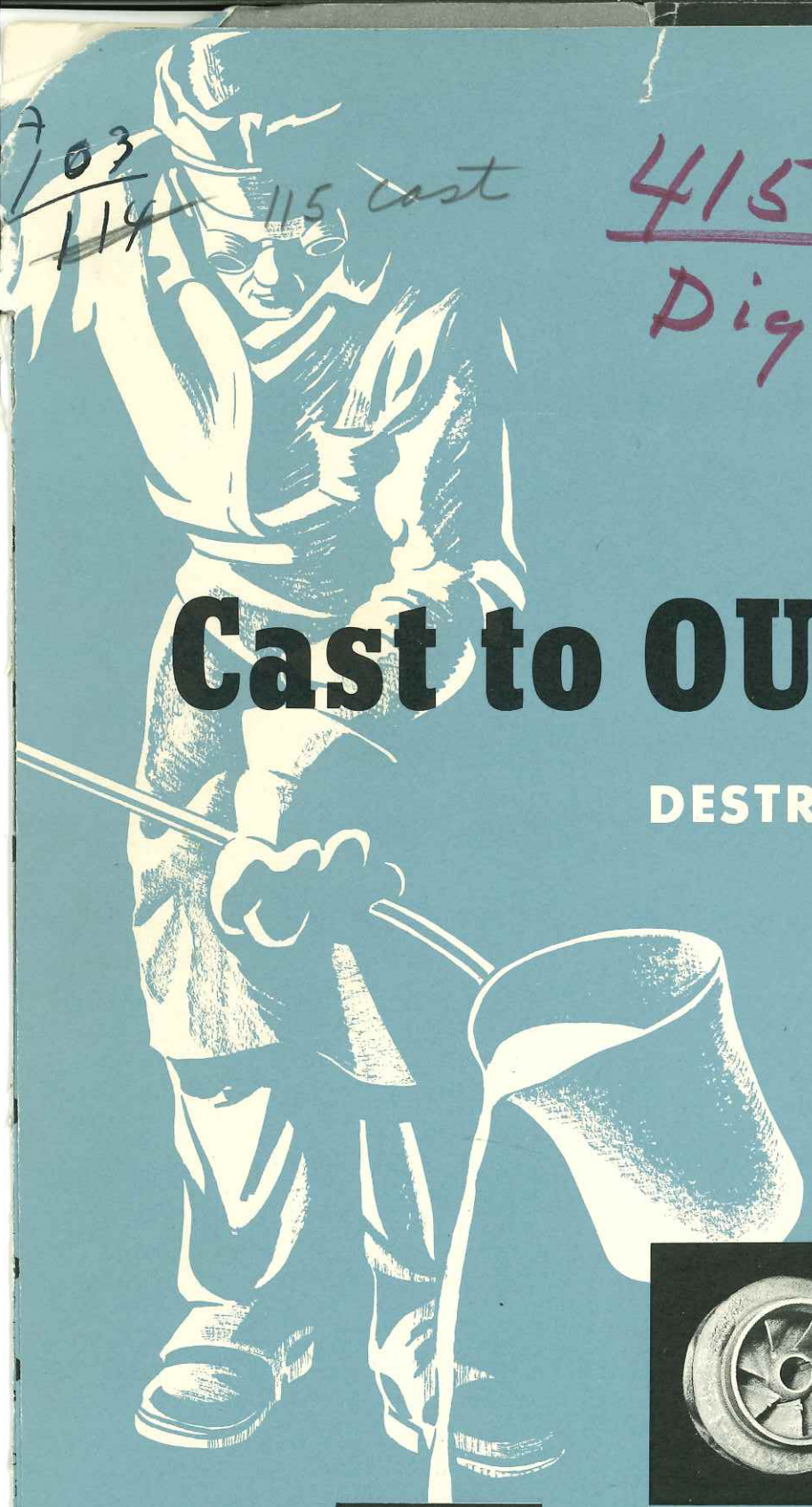
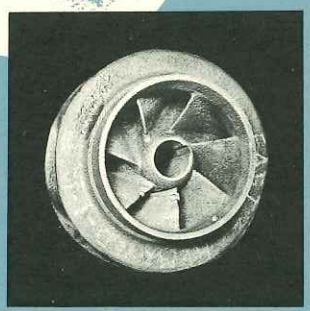


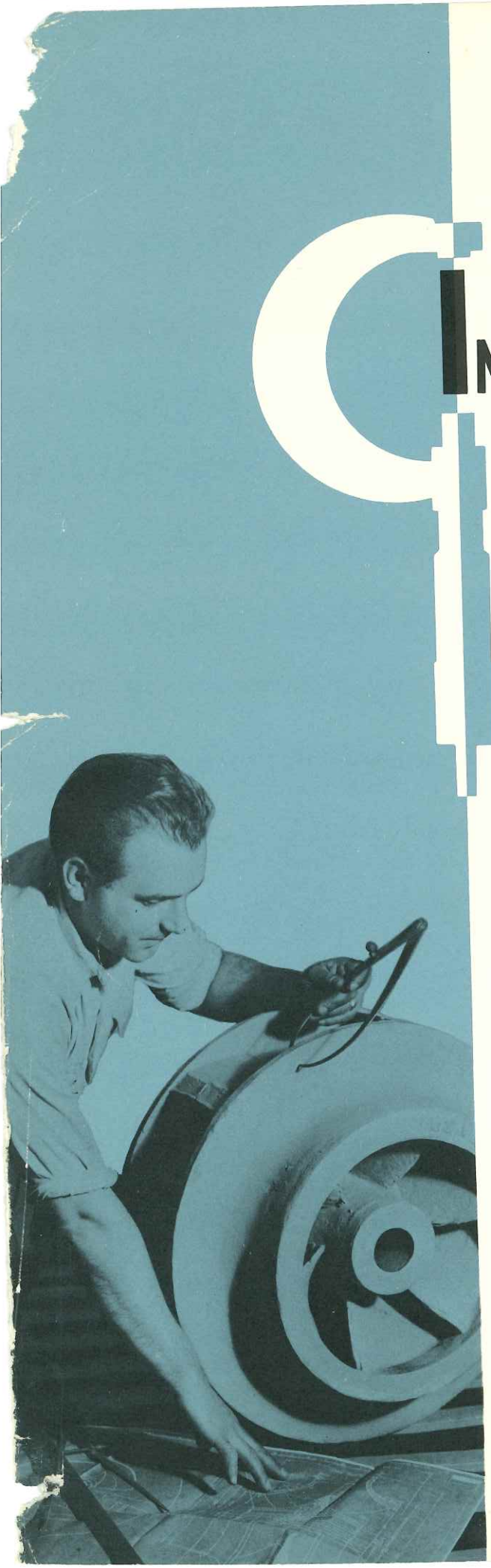
Cast to OUTLAST

DESTRUCTIVE SERVICE



Produced by . . . INTERNATIONAL NICKEL'S OWN FOUNDRY

Received ÷ 9 March 2, 1958



INCO-CAST to Outlast Destructive Service

A PRACTICAL WAY TO HELP YOU MAKE EQUIPMENT PERFORM BETTER, LONGER

Everyone knows the satisfaction that comes when you discover a way to improve your product or lengthen the life of your equipment. Since equipment failure is so often due to a part which logically must be a casting, any development to improve casting performance promises you better, longer lasting equipment.

Here at Inco, the casting alloys we have developed promise just such rewards. For example:

When the maintenance engineer of a large electric power company found that salt water and sand destroyed the sleeves of his circulation pumps in 2½ years or less, he called us in. We cast his sleeves in "S" Monel. Five years ago, he put the first one in service. He has yet to replace an "S" Monel sleeve although he has already gotten twice the service of any previously used metal.

Another engineer was faced with a problem of "coke breeze" that wrecked one cast iron impeller after another in six months or less. He tried an Inco-Cast "S" Monel impeller. It lasted 22 months —3½ times as long. Even then the only reason he replaced it was because other parts were worn.

A filter manufacturer was plagued with small bits of asbestos which chewed into the sleeves of his midget Jordan machine. He had to repack the glands every week. Now that we cast the sleeves in "S" Monel, his sleeves last 10 times as long. And he gets back the price of the "S" Monel sleeves in labor saving alone every two years because he has to repack only 6 times a year.

Still another manufacturer was troubled with the high cost of replacing boiler feed pump impellers that were being ruined by cavitation erosion. When he had the impeller Inco-Cast in "S" Monel, he reported 30 times longer service.

But "S" Monel is only one of eight Inco casting alloys developed to give outstanding service under destructive conditions. In addition to strength and corrosion resistance, each of these alloys has a special combination of properties like resistance to wear, erosion, galling or ability to protect product purity.

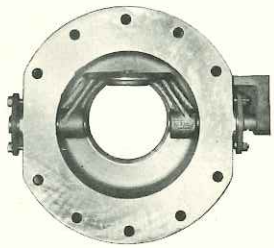
You can get these superior properties in sand, centrifugal or precision castings. And even though you may find they cost more at first, you will find that you can count on them to last so long they cost less in the long run.

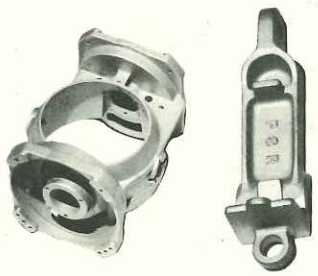
INCO
TRADE MARK

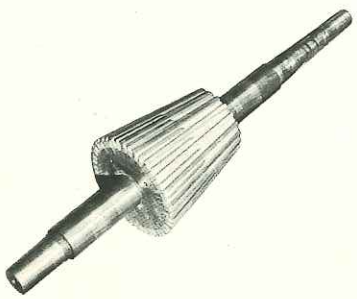
NICKEL ALLOYS

CAST TO OUTLAST AGAINST . . .

CORROSION
ABRASION
HEAVY LOADS
GALLING
HIGH-TEMPERATURE CORROSION
CAVITATION EROSION
STEAM EROSION
. . . AND TO PROTECT PRODUCT PURITY







Why Others Use INCO CASTINGS

At first thought, the longer service life of Inco castings seems answer enough to why others use them. But how can *you* be sure that the Inco casting you get will be more than worth its extra cost?

You may have heard, for example, that Inco Nickel Alloys are difficult to cast. They are. It is not surprising that alloys with such high melting points and superior properties call for superior casting facilities and extensive casting experience. Here at Inco's foundry, we have both.

BUT THAT'S NOT ALL!

You Get These Extra Advantages . . .

1. You get high quality castings because they are made to meet or exceed Government specifications for these high-nickel alloys.
2. You get castings in any practical shape or size you need including centrifugal castings and standard pipe fittings—produced by men who are proud of the saying: "the tough ones wind up at Inco."
3. You get the benefit of Inco's help in solving your metal problems based on wide experience in field and laboratory testing of Nickel Alloys.
4. You get Inco Nickel Alloy castings made at Inco's own foundry; another assurance of sound, dependable castings.
5. You get a choice of eight special-property alloys developed to outlast other materials under destructive conditions. This means you can select the alloy with the most suitable combination of properties to do your job.
6. Even castings you previously thought impractical to produce in Monel, Nickel or Inconel can often be cast by Inco's specialists.

When you need small, intricate cast parts, you get all these advantages plus still others with Inco precision investment castings.

On the following pages are examples of how others have taken advantage of Inco's help to cut their cost through longer service life. The service records others report may suggest how you can benefit by using Inco castings.

INCO PRESENTS
...an 8-Star Cast

★ **MONEL**
an all-around casting alloy . . . one of the most generally useful materials to withstand corrosives encountered in industry . . . has tensile strength comparable to cast carbon steel . . . gives good performance under conditions of abrasion and erosion.

★ **"S" MONEL**
an age-hardenable casting alloy that provides unusual strength, hardness, and anti-galling properties at temperatures up to 1100°F. . . . has general corrosion resistance of Monel.

★ **"H" MONEL**
a casting alloy more machinable than "S" Monel and harder than Monel . . . recommended where greater machinability and intermediate hardness are required.

★ **NICKEL**
a purity-protecting alloy, outstanding for maintaining the purity of foods, pharmaceuticals and many industrial chemicals . . . more than twice as tough as rolled structural steel . . . resistant to a wide range of industrial chemicals, particularly caustics . . . retains much of its strength at high temperatures . . . transfers heat rapidly . . . has useful wear resistance.

★ **"G" NICKEL**
an anti-galling alloy with the corrosion resistance of Nickel . . . recommended for moving parts subject to galling and requiring intermediate strength and hardness.

★ **SILICON NICKEL**
a stronger, harder, anti-galling alloy for applications calling for the corrosion resistance of Nickel.

★ **INCONEL**
a complementary alloy to Nickel for protecting product purity . . . more corrosion resistant than Nickel to nitric acid, fatty acids, ammonium hydroxide solutions and oxidizing conditions in general . . . stronger and harder than Nickel and as tough . . . especially useful in handling corrosive vapors at temperatures in excess of 800°F.

★ **SILICON INCONEL**
an anti-galling alloy with the corrosion resistance of Inconel . . . used in applications calling for Inconel when greater hardness is required.

IT'S EASY TO SELECT
...The INCO CASTING Best Suited to Your Needs

All eight of the cast Inco Nickel Alloys are available as sand or centrifugal castings. As a result, you can select the alloy which has the most suitable combination of properties for your job and have it cast in the form most practical for your needs.

FINISHED FORMS TO CHOOSE FROM

Sand Castings

SHAPE:	any shape practical to cast
CONDITION:	as-cast ("S" Monel frequently is furnished annealed to facilitate machining.)
FINISH:	as-cast, sand blasted, or rough machined
SIZE:	maximum practical: about 2 tons

Centrifugal Castings

SHAPE:	cylindrical tubes
CONDITION:	as-cast or annealed
FINISH:	rough or finish machined
SIZE:	minimum inner diameter: 2 inches maximum outer diameter: over 12 inches on application
maximum length:	***Rough Machined*** 70 inches up to 8-¾ inches O.D. 51 inches over 8-¾ inches to 12 inches O.D.
	Finish Machined 60 inches up to 8-¾ inches O.D. 34 inches over 8-¾ inches to 12 inches O.D.

As you can see, each of the Inco Nickel Alloys has other special properties in addition to outstanding resistance to corrosion and wear. On the following pages are case histories showing how others are making the most of these properties in products they make and use.

One of these records may show how you can solve a problem that has been troubling you for a long time.

Monel, "S" Monel, "H" Monel, and Inconel are Registered Trade Marks of The International Nickel Company, Inc.

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INCO
TRADE MARK

CASTINGS

TO RESIST CORROSION

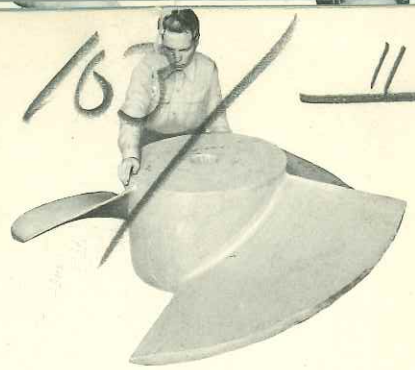
Of all the superior properties of Inco Nickel Alloys, corrosion resistance is the most universally important to industry.

Both cast and wrought Inco Nickel Alloys have the same outstanding resistance to attack by a wide range of corrosives. One or more cast Nickel Alloys are superior in resistance to corrosion by:

Industrial Atmospheres
Fresh and Salt Water
Neutral and Alkaline Salts
Acid Salts
Oxidizing Alkaline Salts
Mineral Acids
Oxidizing Acids
Organic Acids and Compounds
Alkalies
Wet and Dry Gases

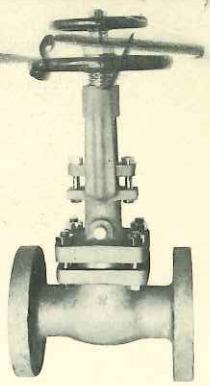
Nickel, for example is more resistant to corrosive attack by caustics than any other commercially available metal. Monel is standard in many applications involving salt water corrosion. And Inconel is the most generally useful Inco Nickel Alloy for resisting corrosion under oxidizing conditions.

Beyond this quick summary, you can obtain more specific data in our bulletin, "Corrosion-Processes-Factors-Testing." A copy is yours for the asking.



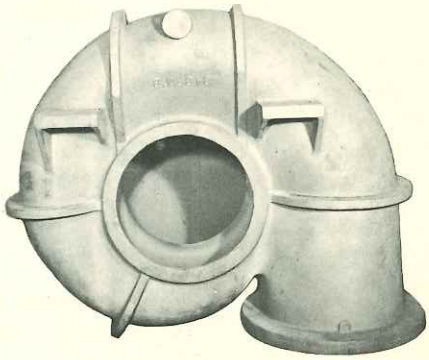
BIGGEST "S" MONEL IMPELLER

Inco ever cast is this 3023-pound casting. It was designed to handle brackish sea water with a mean temperature of 85°F. . . . highly corrosive service conditions. To prevent costly shut downs, a Texas chemical company insisted the impeller be cast in "S' Monel. From previous experience, they know "S" Monel is the alloy that will give trouble-free service under these destructive conditions.



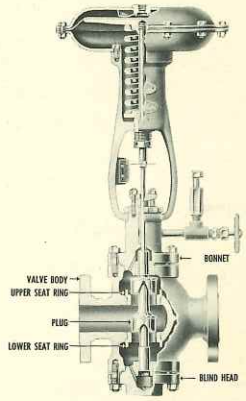
A MATERIAL THAT CAN HANDLE "HF"

Hydrofluoric acid can corrode even glass. It dissolves most metals, and causes others to puff up like a sponge. That's why cast Monel valves and pipe fittings are standard items for handling potent HF. Monel castings also successfully withstand hydrochloric, sulfuric, and most other acids under a wide variety of conditions commonly encountered in industry.



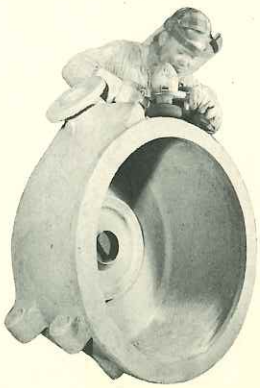
DOESN'T LOSE ITS HEAD

Pumping 14,300 gpm of hot caustic (219°F.) in an evaporator is a severe test for any metal. So it wasn't surprising when a leading pump manufacturer specified Inco-Cast Nickel for this 3370-pound caustic pump casing. When it comes to handling caustics, *Nickel is superior to any other commercially* available metal.



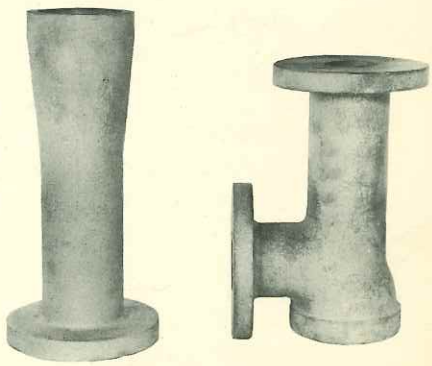
SLICK ANSWER TO OIL PROBLEMS

No problems, no complaints is the result since a well known regulator company switched to Inco-Cast Monel for the body, plug and seat ring of his valve. Used whenever the severe corrosives commonly encountered in the petroleum industry are to be handled, cast Monel gives the trouble-free service required for accurate performance of this regulator.



A HARD-TO-BEAT COMBINATION

A centrifuge handling caustics and spinning with a force 1200 times that of gravity requires a metal with a hard-to-find combination of properties. That's why a leading manufacturer of centrifuges has standardized on strong, corrosion-resistant Monel for parts such as this bowl casing.



A RUGGED ASSIGNMENT

Handling corrosives like chlorine, fluorine and bromine under pressures that go as high as 6000 psig calls for a metal with exceptional properties. That's why a leading manufacturer of flow meters has standardized on Inco-Cast Monel and Nickel for those parts of the meter which come in contact with these corrosives.

INCO
TRADE MARK

CASTINGS

TO RESIST . . . HIGH-TEMPERATURE CORROSION

Where corrosion and high temperatures combine to shorten equipment life, many manufacturers and engineers use Inco castings to get longer service. You find Monel castings in continuous operation, resisting oxidizing atmospheres up to 1000°F. . . . and, in some cases, even higher. Nickel and Inconel have been used successfully in installations up to 1500°F. "S" Monel castings offer valuable anti-galling properties for parts exposed to high-temperature steam, and are used extensively for seat pins, wedges, and other types of trim in steam valves operating at temperatures as high as 1100°F.

And TO PROTECT . . . PRODUCT PURITY

When corrosion and other destructive chemical reactions affect the purity of your product, there is a good chance an Inco casting will prove to be a ready answer to your problem.

Castings in the various types of Nickel and Inconel are known for their ability to protect the purity, color, odor and flavor of foods, pharmaceuticals, alkalies and other substances which may be contaminated by ordinary metals. Numerous investigations have established that the tolerance of food products for Nickel is greater, on the whole, than for any other commercial metal. For short-time exposure applications, Monel is frequently used.

Fruit juices and alcoholic beverages are often processed and handled in Inconel because of its ability to prevent metallic contamination. In handling fatty acids, dyestuffs and other severe corrosives, Inconel is relied on to keep pure products pure. And Inconel is especially useful in many pharmaceutical applications where product purity is, of course, essential.

ALL STEAMED UP

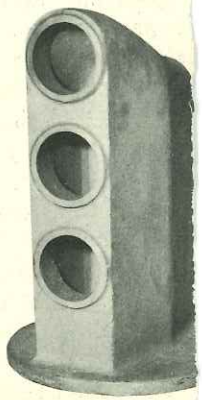
Used to generate steam for heating large bombers, this Glycol heat exchanger was cast at Inco's foundry in Inconel. Inconel was chosen to resist corrosion from 1250°F. steam—normal operating conditions for this casting. Inconel is a standard material for many aeronautical applications because of its high resistance to oxidation and ability to withstand the corrosive by-products of combustion.

FITTING SOLUTION . . .
. . . FOR HOT GA

These special cast fittings of pure N are part of a giant ammonia oxidation tem, where temperatures rise to 150 For the hottest spots in these syst Silicon Nickel is used. Similar cast Ni tees, used with rolled Nickel covers, found throughout the chemical indu

STOCK ITEM

So many food mixing machines call for the purity protecting ability of Monel that Inco now stocks small size agitators cast in Monel. This little fellow, weighing only 5 ounces, can whip a mean potato. Monel is used for many types of food processing equipment where short-time exposure is normal.

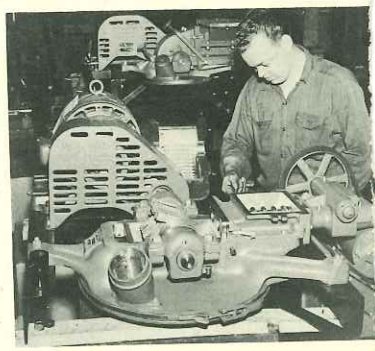


GUARDIAN OF PURITY

For many seasons, this cast Nickel header for a huge cooking coil of pure Nicke protected the purity of the food it hel process. This casting is used on a unit sisting of an outer coil 60 inches in d eter and an inner coil with a diamet 42 inches. Fitting into a large kettle c containing the food product, this N casting heats but does not contaminat tomato products being processed.

AN ANSWER WITH A SMILE

With all the chlorophyls, ammonia compounds and other new ingredients being added to toothpaste, it takes corrosion-resistant, purity-protecting metals like Monel and Inconel to guard purity. This filter for a well-known brand, still in excellent condition after 5 years of service, has an Inco-Cast Monel body. Freedom from harmful metal contamination is also assured since most of the working parts as well as the tank and piping are Monel.



24-HOURS-A-DAY

This pulverizer, used in the productio saran, must give trouble-free perform —even when run by inexperienced op tors. To insure that the transparent s is not stained during production, all of this pulverizer which come in co with the saran are Nickel. Cast part clude: the trough, housing cover, co gate, relief elbow, body, sleeve, and

INCO
TRADE MARK

CASTINGS

TO RESIST ABRASION

Where abrasion grinds away ordinary metals, it takes harder, stronger, tougher metals to cut down the cost of constant replacement of worn-out parts. Here the specially developed modifications of Monel, Nickel and Inconel are particularly useful. Although Monel itself withstands severe abrasion, if you have a part that must withstand especially severe wear, "S" Monel or "H" Monel will provide extra wearability. For example, tests have shown "S" Monel retains from 81 to 94 per cent of its hardness (275-350 Brinell as-cast) at temperatures as high as 1100°F. (In fact, annealed "S" Monel shows *increased* hardness at 1100°F.)

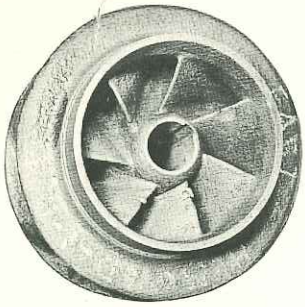
If, on the other hand, service conditions call for the corrosion resistance of Nickel or Inconel, you can get extra wear resistance with Silicon Nickel, "G" Nickel or Silicon Inconel.

and TO RESIST GALLING

Whenever abrasion is a problem, its ugly brother, galling, is apt to be close at hand. The wear-resisting cast Nickel Alloys are also superior in their resistance to this life-shortening condition. Here, again, the special modifications of Monel, Nickel and Inconel provide extra gall resistance in rubbing contact.

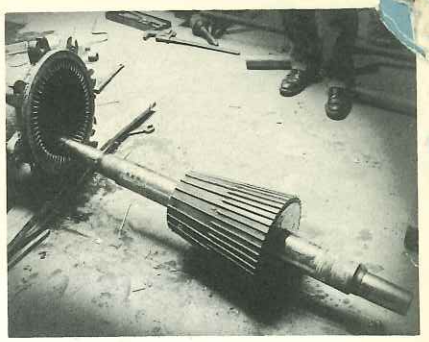
"S" Monel, an alloy of proved anti-galling characteristics, combines the general corrosion resistance of Monel with unusual ability to withstand galling. "H" Monel provides useful resistance to galling and greater machinability.

When you need an anti-galling alloy with the properties of Nickel, "G" Nickel may suit your need. And you will get still greater strength and hardness combined with gall resistance when you use Silicon Nickel. Similarly, in applications calling for Inconel, you can get increased gall resistance with Silicon Inconel.



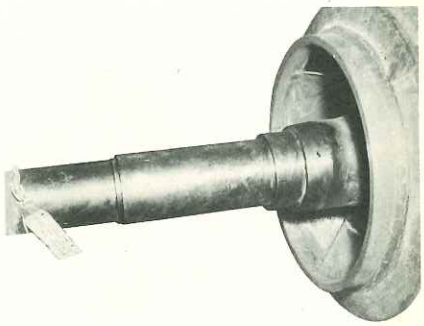
TALE OF TWO IMPELLERS

"Coke breeze" usually wrecked cast iron impellers within six months at one gas company. Then this Inco-Cast "S" Monel impeller was installed. It served without trouble for 22 months—3½ times as much service. Its replacement was used for 10 months before the company switched fuels, eliminating need of the impeller. After giving nearly twice the service of previous impellers, the replacement was in such excellent condition it was *sold* to another gas company.



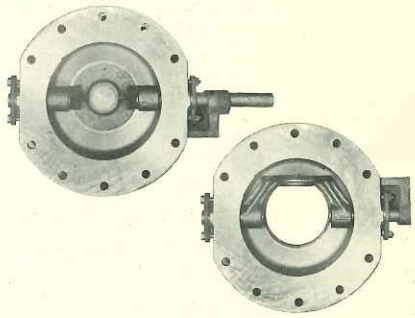
"TEN TIMES AS MUCH SERVICE"

That's what a filter manufacturer says of the two "S" Monel sleeves on his midget Jordan machine for grinding raw asbestos. Formerly, the sleeves that protect the shaft against abrasive asbestos lasted only 15 months. Wear was so severe they had to repack the glands weekly. Now, with "S" Monel sleeves, the company repacks glands only six times a year. "In labor saving alone, we have already gotten back the price of the "S" Monel sleeves."



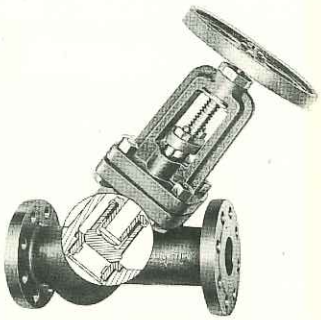
THE SLEEVE THAT COSTS LESS THAN PLAIN WATER

A power company used to replace circulating pump sleeves within 2½ years—often sooner. Sand accumulated in the glands. Engineers considered lubricating the gland with plain water; then decided to try "S" Monel sleeves first. Not only do "S" Monel sleeves last twice as long, "The extra cost of a new "S" Monel sleeve—installed—is less than the added cost of supplying plain water to the gland."



AN OPEN AND SHUT CASE

Every 3rd minute, 24 hours per day, 5 days per week, for over 5 years . . . 1¼ million times in all . . . a dry valve similar to this has opened and closed. It handles gritty, abrasive, limestone-like powder that liberates highly corrosive fluorine. To keep the valve from sticking, the designers wanted the disk to wipe across the seat with a self-cleaning motion. But how to prevent galling? They had Inco cast the body and disk in Monel, the seat in "S" Monel.



SEVEN YEARS WITHOUT A COMPLAINT is the experience of the manufacturer of this blow-off valve. To withstand the terrific erosive conditions as well as abrasion and corrosion, they chose Monel for the seat. And for the disc which is directly in the line of high-temperature water jetting through the opening at pressures up to 600 psi, they needed a harder though machinable alloy. "H" Monel solved their problem here.

THE PUMP THAT SHOVELS

Liquids literally thick enough to pick up with a shovel are handled in this pump. This completely reversible rotary pump can handle up to 400 gallons a minute of fluids 800 times more viscous than water. For handling crushed fruit and vegetables, syrups and molasses, the pump must have the purity protection of Nickel plus resistance to galling in all moving parts. The manufacturer finds "G" Nickel provides the needed combination of properties.

INCO
TRADE MARK

CASTINGS

TO RESIST EROSION

When steam- or cavitation-erosion reduces service life, it will pay you to investigate Inco castings. High-pressure steam that cuts most metals like a sand blast finds a worthy opponent in cast Monel and more than its match in "S" Monel. For these alloys retain their original dimensions for years under high temperatures, high pressures and highly corrosive conditions.

When the tiny bubbles in a swirling liquid collapse and blast against metal parts with the force of bullets pinging against concrete, they call it cavitation-erosion. The high resistance of "S" Monel and Monel to cavitation's vicious action is one of the chief reasons for their long life in cast pump impellers, agitators and valve parts.

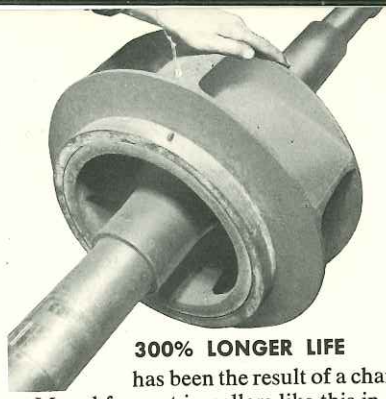
In every field from chemical processing plants to central power stations, Inco castings are found ensuring long, trouble-free performance.

and to PROVIDE STRENGTH

It doesn't matter how resistant a casting is to erosion, corrosion, abrasion, galling and product contamination if it isn't strong enough to stand up under heavy loads. Whenever castings are being weakened by these destructive conditions and broken by shock and heavy loads, an Inco-Cast Nickel Alloy generally provides a practical solution to the problem.

Cast Monel is as strong as cast carbon steel. Nickel is twice as tough as rolled structural steel. And Inconel combines the strength of Monel with the toughness of Nickel. For applications calling for still greater strength, age-hardenable "S" Monel is a logical choice.

In sub-zero temperatures, which weaken and make brittle most metals, Inco Nickel Alloys retain their ductility and toughness and their strength and hardness *increase!*



300% LONGER LIFE

has been the result of a change to Monel for cast impellers like this in one utility company. Previously, erosion ate the bronze impellers of their circulating pumps into complete inefficiency within 18 months. Attack by salt water containing sewage wastes hastened the destruction. Now these impellers are Inco-cast in Monel, give 4 to 5 years of service. This longer life means higher average efficiency of the pump which often completely overshadows impeller costs.

SURVIVES STEAM BLASTING

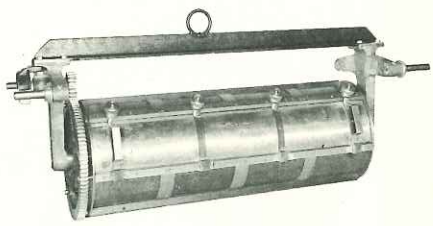
at three times the speed of sound fo[r] years. Since the size of the orifice remain exactly the same throughout of service, manufacturers of steam ejectors use Monel castings for no Steam blasts through them at 3 time[s] speed of sound under pressures up t[o] pounds per square inch and tempera[tures] as high as 800°F. Yet a number of original cast Monel nozzles, installe[d] years ago in ejectors, are still operati[ng] excellent condition.

30 TIMES LONGER LIFE

In less than 4 weeks, cavitation-erosion ruined this bronze impeller—specially designed for a high speed Weir-type boiler feed pump. It was replaced with an "S" Monel impeller of exactly the same design. At last check, the "S" Monel casting had outlasted the bronze 30 times, and was still in excellent operating condition after 2½ years.

3 TIMES AS MUCH SERVICE

as cast bronze is the main reason a leading pump manufacturer has standardized on Inco-Cast Monel impellers for the first stage in his centrifugal circu[lating] pumps. Cast Monel and "S" Mon[el] outstanding in their ability to with[stand] the vicious action of cavitation caus[ed] dissolved gases, entrapped steam, or turbulence blasting against impeller [vanes]



RECIPE FOR LOW-COST PICKLING

An extra-strong, corrosion- and wear-resistant metal is needed for tumble-pickling barrels, used in cleaning metals That's why pickling barrels, like this one, are made of Monel. The gear-end idler, idler-end hanger, ring gear and pinion must support the heavy burden of the load . . . stand up under the tortuous grinding of the gears . . . the constant jouncing of the barrel. And, of course, they must resist the corrosive action of acid and alkaline solutions used in the process. These are the reasons all these load-carry parts are Inco-Cast Monel.

EXPLODED VIEW OF EXPLOSIVE-HANDLING VALVE

When handling highly corrosive gases or liquids with explosive, inflammable or poisonous characteristics, the greater [the] of safety in a valve, the better. To p[re]vent weakening by corrosion and provi[de] extra assurance of strength, the bo[dy] this all-Nickel valve is cast by Inco. [tests] involving as many as 1-million [cycles] prove the high resistance of fatigue [pro]perties possessed by Inco-Cast Nickel.

How To Make

BIG SAVINGS

On Small Parts

with **INCO PRECISION CASTINGS**

IN FERROUS AND NON-FERROUS METALS

WHAT METALS?

Inco precision casts practically all the high-melting-point metals from ordinary carbon steel to the new super alloys. If the part you are considering will be subject to only ordinary operating conditions, you can have it precision cast in one of the inexpensive low alloys. And if the part must withstand destructive service conditions, you can choose one of the cast Inco Nickel Alloys.

If you were to ask 100 companies buying Inco precision investment castings why they use them, 99 would answer your question something like this:

"We buy Inco precision castings to cut our cost on this part."

The 100th company would have a slightly different reason: "The part can't be made any other way at a practical cost."

Savings as high as 60 per cent (and higher) are now reported by manufacturers who have small parts precision cast by Inco.

Savings like this are possible because precision casting frequently reduces or even eliminates fabricating steps. In addition to probable cost saving, however, there are sometimes more important reasons for using Inco precision castings:

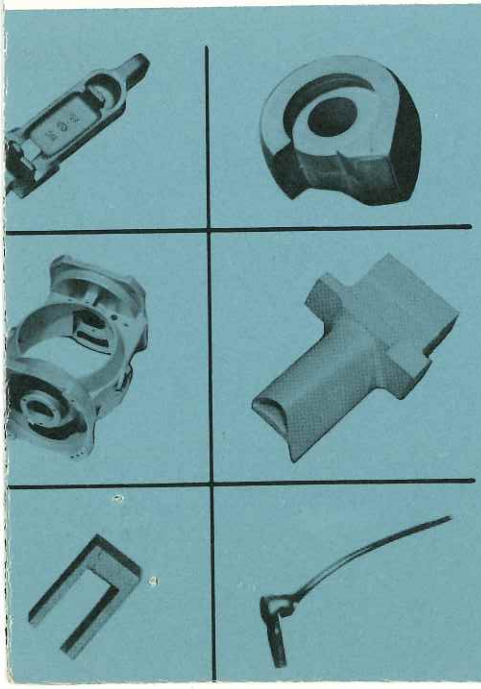
Often you can reduce your machinist bottleneck because fewer machining operations are needed.

Fewer or no machining operations mean you can use hard —or impossible-to-machine metals.

You have greater latitude in designing because intricate shapes that are not practical to make by conventional methods can often be precision cast.

You can use a higher alloy that would have been too costly because there is little or no scrap left over.

The best way to find out whether or not precision casting will cut your production costs is to let the casting specialists at Inco's foundry study the part you have in mind. Just send us a sample or blueprint, and we will tell you immediately whether or not it will pay you to look into having it precision cast. Then, if precision casting seems practical, our casting specialists will work out the most efficient way to cast the quantity you have in mind and give you a quotation on it.



THUMB RULE FOR SELECTING PARTS TO BE PRECISION CAST

Whenever you have a part which is 6 inches x 5 inches or smaller, weighs under 3 pounds, requires starting tolerances as close as plus or minus .005 inch per linear inch, and would require 5 or more fabricating steps, there is a good chance you can cut costs by having it precision cast by Inco. In special cases, any of these design requirements can be exceeded.

INCO
TRADE MARK

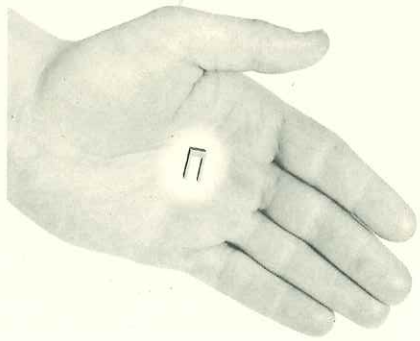
PRECISION CASTINGS

CUT COSTS

Each new design involves so many different cost factors that there is a different reason for choosing precision casting in nearly every case. That is one of the beauties of precision casting —that it lends itself to so many different ways to save.

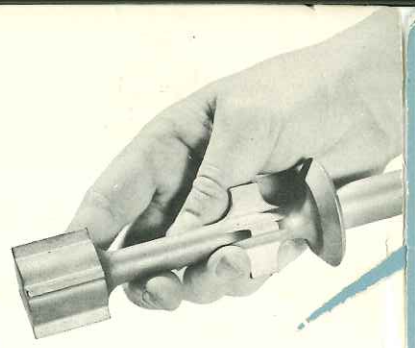
In general, the way precision casting cuts costs is by reducing or eliminating fabricating steps. But the reason Inco precision casting will cut costs on some part of your own may be one or several of the following:

- You can have several parts precision cast as a single piece to reduce or eliminate assembly costs.
- When you need several parts which are identical in all but one or two dimensions, often you can have the parts produced as a single casting. Then a slight machining change will turn the casting into any one of the parts you currently need.
- You can often eliminate welding, brazing, soldering or mechanical joining by having parts precision cast.
- The soundness of precision-cast parts means you have fewer rejects and less spoilage.
- Precision casting often permits you to make design changes which would be too costly by conventional fabricating methods.
- The quantity you need of some small part that logically would be made by automatic screw machine is not sufficient to warrant the extra equipment.



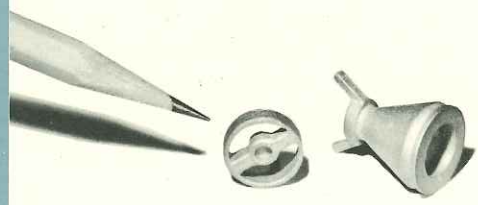
PROBLEM: Twenty-three of these tiny, stainless steel lugs are used in a surgical suturing device. Costs for machining them out of bar stock were out of line.

SOLUTION: Inco precision casts these lugs so that only a slight touch on the grinding wheel is needed to finish them. Cost is cut 60% compared with machining.



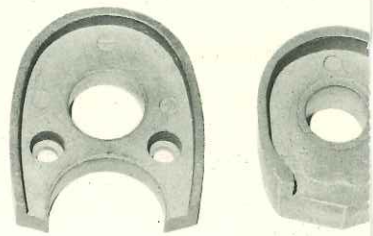
PROBLEM: Machining this valve sten railroad tank cars was costly becau the large amount of scrap that resu When it was sand cast and mach. costs came down, but not enough to sa the manufacturer.

SOLUTION: The stem is precision ca Inco so that it requires only finish ma ing. Part is cast in Monel to withstand rosive attack from chlorine handled i tank cars. Cost is cut nearly in half.



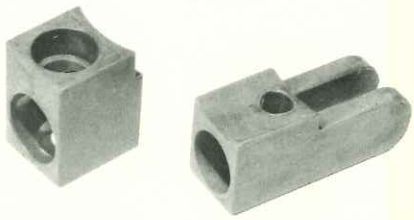
PROBLEM: Costs on this collet head and spreader for liquor dispensing equipment seemed high. The round collet head required ten costly operations to produce it and about half the bar stock was machined away as scrap. The collet spreader was machined in three pieces which had to be brazed together.

SOLUTION: Precision cast by Inco, each part requires only lapping and drilling one hole. On both parts, a tolerance of .003 inch per linear inch is held. Parts are cast in Inconel to protect color and flavor of liquor. Costs are cut 15% on spreader, 30% on head.



PROBLEM: Forging this jig cap an from mild steel bar stock, then broac and machining them was too expensiv

SOLUTION: Inco precision casts the so that lapping, grinding and drilling holes is all that is necessary to finis parts. Both parts are cast in 18-4-1 speed steel. Costs are cut 37%. W more, the precision-cast parts give ap imately three times longer service lif



PROBLEM: Estimates on machining these two parts out of bar stock seemed excessive to the manufacturer of a fastening tool. One part would require 8 operations and 4 set-ups. The other would take 12 operations and 8 set-ups.

SOLUTION: When precision cast by Inco in 1020 steel, one part needs only 2 simple machining operations and the other needs none before hardening and finishing. Both parts are cast for less than half the estimated cost of machining.

PROBLEM: Machining costs on this i tor nozzle were way out of line. separate parts were needed . . . 38 h to be drilled at precise angles . . . 4 se threads to be cut . . . and an odd co shape had to be machined within the The design could not be changed wit sacrificing efficiency, so . . .

SOLUTION: Inco precision cast the nc in three parts which need only finish chining. Nozzle is made of Monel to r erosion and corrosion caused by su ether, and abrasives found in the handled by this atomizer. Result: assembly, less machining, cost cut 2

INCO
TRADE MARK

PRECISION CASTINGS

ELIMINATE ALL . . . . . OR MOST MACHINING

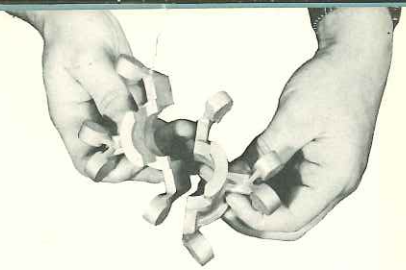
One of the main reasons Inco precision casting cuts costs is because it reduces or eliminates machining on small parts.

Like many precision casting users, you will find many different advantages in being able to obtain small parts that are ready or nearly ready to use as-cast:

- Fewer machining setups
- Surfaces so smooth little or no finish machining is needed. (Inco regularly produces precision castings with a surface finish of 60 micro-inches, and, in special cases, as high as 125 micro-inches.)
- Less tool wear and breakage
- Cost of special dies, tools and machines eliminated
- Less handling of parts between machine operations
- Fewer inspections
- No machining time lost on parts with internal defects
- Less handling of raw material stock
- Lower inventory of expensive alloys
- And most important—less machining also means you can free your machines and *machinists* for other work.

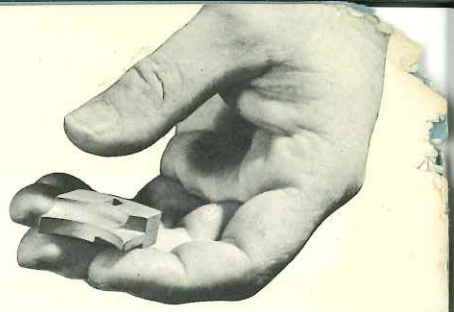
and PERMIT USE OF HARDER ALLOYS

No longer must you accept an inferior substitute because the metal you want to use is impossible or too expensive to machine. You can have even the hardest metals "machined-in-the-mold" by Inco precision casting. You can also have the same part precision cast in more than one alloy to suit individual service requirements—without additional patterns and dies!



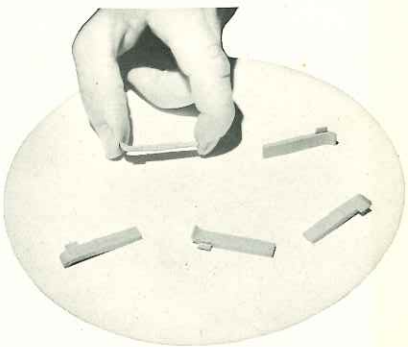
PROBLEM: These two parts which make up the collar on an under-water sonar device were costly to make. The two main parts were machined from bar stock. The four paddle brackets were machined from weldments. (Blanking, forming and pre-machining were needed to produce the weldments.) After finish machining, all six parts had to be assembled with screws.

SOLUTION: Inco precision casting reduces the 6 parts to 2; eliminates all blanking, forming, pre-machining and welding; lessens finish machining and makes final assembly of the collars far easier.



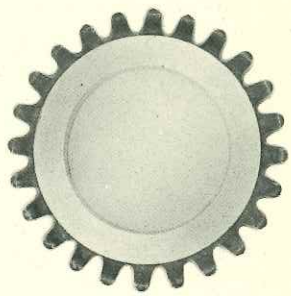
PROBLEM: Machining this wedge for a milk-bottle capping machine took 13 operations to complete (more if you count rough and finish cuts separately). In addition to the high cost, all this machining tied up equipment and machinists.

SOLUTION: Now the wedge is precision cast by Inco. It takes only 9 machining operations . . . four of them simply light, finish cuts. Machining time cut 75%. What is more, with a slight change in one machining step, a single casting can be adapted to any one of 3 wedge sizes.



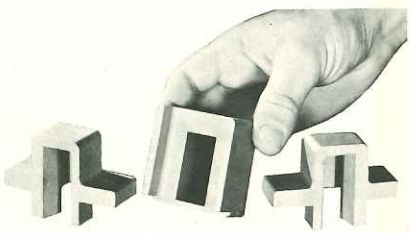
PROBLEM: Machining thousands of these little parts out of SAE 4340 steel was not only a costly job—it was jamming up the manufacturer's shop and tying up machines and machinists needed for other work.

SOLUTION: Inco precision cast this part to such close tolerances that only finish machining is now needed. Costs are cut 10%, machine shop bottleneck is eased.



PROBLEM: Machining, finishing and cleaning the notches of this adjusting ring for a relief valve was the big reason costs were out of line on this part.

SOLUTION: Inco precision casts the entire ring in nine different sizes, eliminating most machining and greatly simplifying cleaning of the notches. Machining time is cut approximately 25%—and parts have better finish than when previously sand cast and machined.



PROBLEM: These parts which form the latching mechanism on laundry machines take a terrific beating in the field. They must be strong and hard enough to withstand severe shock as well as be able to resist galling and corrosion. "S" Monel seemed the most logical choice but all the forging, broaching, soldering, drilling and facing ruled it out until . . .

SOLUTION: Inco precision cast the parts as single castings requiring only finish machining. Costs are cut about ⅓—now it is practical to use "S" Monel.

PROBLEM: This latching cam for a retrievable gas lift valve had to resist oil well corrosives, be strong enough to take the pressures, and be hard enough so it wouldn't gall, seize, or change shape despite years of exposure to corrosion, abrasion, shock and pull. The cost of machining it out of bar stock was prohibitive.

SOLUTION: Inco precision casts the part in "S" Monel, eliminating all machining except drilling and lapping. Cost is cut 84%—use of "S" Monel is now possible.

INCO
TRADE MARK

PRECISION CASTINGS

GIVE YOU GREATER DESIGN LATITUDE

How many times have you had to shelve a blueprint simply because some small part couldn't be made at a practical cost? With Inco precision casting, you can dust off that favorite blueprint and take another look at the part that is holding things up. There is a good chance we can precision cast it for you at a practical cost.

More than that, with precision casting it may be possible to improve the part in some way . . . better finish . . . lighter sections . . . more suitable metal . . . less assembly. As you glance over some of the typical parts shown on this page—each one made possible by precision casting – perhaps some part that you have discarded as impractical will come to mind. If so, let us know about it. We may be able to work out a practical way out of your difficulty.

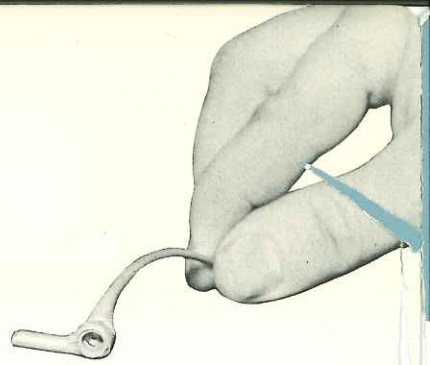
AND PERMIT YOU TO USE HIGHER ALLOYS

It is a surprising fact that the cost of the metal in a precision casting is a relatively small part of the overall price. But it is less surprising when you remember that scrap loss from precision casting is practically nil. For example, if a part necessitates machining away half the bar stock, it would cost about the same if you had it precision cast in an alloy costing *twice as much!*

The fact that higher alloys cost so little more when precision cast gives you a wide selection of alloys from which to choose the one most suited to your needs. More than that, it is possible to have the same part cast in a variety of alloys in molds from the same master pattern. This gives you a practical way to test several metals to determine which is best suited to your purpose. It also means that a valve manufacturer, for example, can have a critical part cast in one alloy for general service and a higher alloy for more severe service.

PROBLEM: As small as this cam shaft is, it would require as many as 6 turning operations, 6 milling operations, and lapping—plus the fact that more than half the 1-inch bar stock would be machined away into waste.

SOLUTION: Inco casting specialists precision cast the part to tolerances of plus or minus .005 inch per linear inch. All that is needed to finish the part is a little lapping and a slight straightening of the shaft.

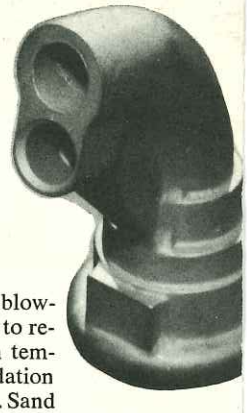


PROBLEM: Machining this pick-up fir for a fishing reel was out of the quest Yet the only alternative was redesign a new, spinning type reel.

SOLUTION: Inco precision casts the fin in "H" Monel to provide the stren hardness, and corrosion resistance to water needed for this service. Produc costs were brought in line; redesign eliminated.

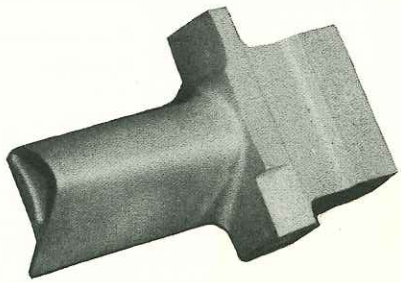
PROBLEM: A leading gyro manufacturer needed several different gimbal parts produced in SAE 8620 steel. Quantities didn't permit making special machinery for each part. But to fabricate the parts by conventional methods would be prohibitively expensive.

SOLUTION: Inco precision casts each part so that the only machining necessary is at critical areas plus drilling for mounting. These intricate parts are produced in less time and at a fraction of the cost of machining.



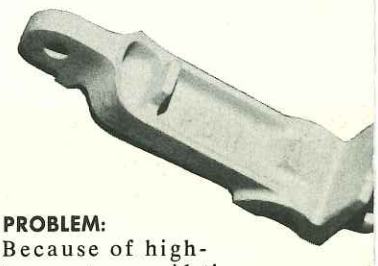
PROBLEM: This scarfing blowpipe head has to resist both high temperature oxidation and corrosion. Sand cast in a low alloy and hard surfaced v a cobalt-base alloy, costs were plenty h

SOLUTION: Inco precision casts the in "S" Monel. Costs are cut 35% though solid "S" Monel is used.



PROBLEM: This power recovery bucket for an airplane engine would be extremely expensive to fabricate. To get the proper high-temperature strength and resistance to oxidation and corrosion from exhaust gases, an alloy which was also extremely hard had to be used.

SOLUTION: The bucket is precision cast by Inco in a cobalt alloy with a Rockwell C hardness of 27. With machining minimized by precision casting, it is possible to use this higher alloy.



PROBLEM: Because of high-temperature oxidation and the danger of spark erosion, the m of this carbon jaw for motion pic projectors wanted to use Nickel. But cost of machining this part from a casting in a lower alloy was out of

SOLUTION: Inco precision cast the in Nickel which outlasts previously material 5 to 1. Manufacturer now Nickel—and pays 15% less for the

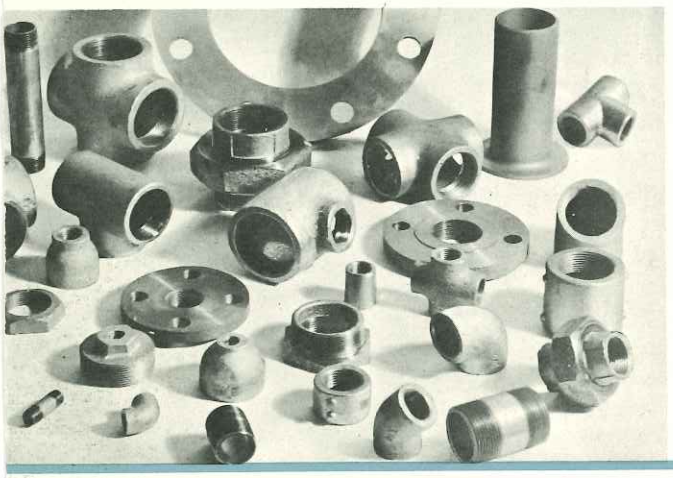
INCO CASTINGS

FROM STOCK

Pipe Fittings

When corrosion, temperature extremes or product contamination present problems in maintaining your piping system, Inco-Cast Monel, Nickel and Inconel pipe fittings frequently will fit your needs to a "T."

A handy, price list catalog containing full information is yours for the asking.



9 Good Reasons for Inco-Cast Fittings

- Resist most corrosives
- Withstand high and sub-zero temperatures
- Strong . . . tough . . . sound
- Protect product purity
- Economical in cost
- All standard types and sizes in threaded and welding fittings
- Special shapes and sizes made to order
- Pressure-tested
- Fast service to all points from conveniently located distributor stocks

Bushing and Bar Stock

To fill the long felt need for bushing and bar stock capable of withstanding destructive conditions, we are now stocking centrifugally-cast "S" Monel bars. They come in both solid and cored forms, 13 inches long, and are annealed and rough-turned. The bars as furnished from stock allow up to 1/16 inch over the sizes† shown below to provide for finish machining.

Savings made possible by rough turning and annealing frequently offset additional initial cost over regular castings in the as-cast condition.

This partial list of typical uses for "S" Monel bushing and bar stock may suggest an application in which you can take advantage of this convenient cast form.

- *Bushings for pumps*
- *Chain bushings*
- *Valve seats*
- *Spray nozzles*
- *Wearing sleeves*
- *Non-lubricated bearings*
- *Agitator foot bearings*
- *High-temperature bearings*
- *Instrument and meter parts*
- *Continuous and rotary pickling machinery parts*

SOLID*		CORED		
Diameter (Tol.+1/16")		Inside Dia. (Tol.—1/16")		Outside Dia. (Tol.+1/16")
¾	2	1	x	2
1	2¼	1	x	2¼
1⅛	2½	1	x	2½
1¼	3	1	x	2¾
1⅜	3½	1½	x	3
1½	4	1½	x	3½
1¾		1½	x	4
		3	x	4½
		3	x	5

**Also available in 6½-inch lengths.*
†Production quantities of special sizes on application.

Quick Facts

ABOUT INCO CASTINGS

Here is a quick summary of data on Inco castings to answer preliminary questions that may come to mind. More specific information on properties, operating instructions, and specifications is given in technical bulletins available or in preparation on each cast Nickel Alloy.

JOINING

All Inco castings can be welded by the metal-arc, inert gas metal-arc, or oxy-acetylene processes if proper procedures are followed.* Joining of "S" Monel and Silicon Inconel castings by welding is not recommended. Inco produces a complete line of special composition welding wires, electrodes and fluxes to assure you of predictable, sound welds. Detailed instructions for welding Inco castings are given in Technical Bulletin T-2.

**When production welding of Monel, Nickel or Inconel is required, be sure to let us know when ordering castings. A special welding grade of these alloys can be supplied.*

All Inco castings including "S" Monel and Silicon Inconel can be silver-brazed if proper procedures are followed. Instructions are given in Technical Bulletin T-34.

Soldering Inco castings is not recommended when joints will be subject to mechanical stress. Soldering can be used for sealing purposes providing the corrosive environment or temperatures do not adversely affect the solder.

MACHINING

All Inco castings can be machined in the as-cast condition. When more than a limited amount is necessary on age-hardenable grades such as "S" Monel, it may be desirable to anneal the casting to facilitate machining; then age-harden it. Details on machining Inco castings are given in Inco's Technical Bulletin T-12.

PROPERTIES

Material	Form and Condition	Average Mechanical Properties†				Average Physical Constants†						
		Yield Strength (0.5% offset) 1000 psi	Tensile Strength 1000 psi	Elongation in 2 in., per cent	Hardness Brinell	Density lb./cu.in.	Specific Gravity	Melting Point °F.	Specific Heat (32°-212°F.) Btu./lb./°F.	Thermal Expansion Coefficient (32°-212°F.) 10⁶ in./in./°F	Thermal Conductivity (32°-212°F.) Btu./sq.ft./hr./°F./in.	Electrical Resistivity
Monel	As-cast	32-45	65-90	25-50	125-150	0.312	8.63	2400-2450	0.13	7.6	186	3
"S" Monel	Annealed As-cast Age-hardened	55-90 80-130 85-130	100-125 120-145 120-145	5-15 1-4 1-4	175-260 275-350 300-380	0.302	8.36	2300-2350	0.13	7.6	136	3
"H" Monel	As-cast	45-80	75-115	10-20	175-250	0.305	8.48	2350-2400	0.13	7.6	180	3
Nickel	As-cast	20-30	45-60	15-30	80-125	0.321	8.89	2615-2635	0.11	7.2	420	
Inconel	As-cast	30-45	70-95	10-30	160-190	0.304	8.51	2540-2600	0.11	6.6	104	5

†Included to facilitate comparison. Not recommended for use in specifications or design.

NICKEL ALLOY CASTINGS

(SAND, CENTRIFUGAL AND INVESTMENT[1])

MATERIAL	SPECIFICATIONS
Monel	QQ-C-551[2] MIL-N-20164[2]
"H" Monel	MIL-N-4498 (USAF) (Comp. I) MIL-N-20165 (Class A)[3]
"S" Monel	MIL-N-4498 (USAF) (Comp. II) MIL-N-20165 (Class B)[3]
Nickel	Available—no applicable Government Spec.
Inconel	Available—no applicable Government Spec.

[1] The requirements of the specifications listed may not be suitable for investment castings. Consult INCO for recommendations on specs. for nickel-alloy investment castings.

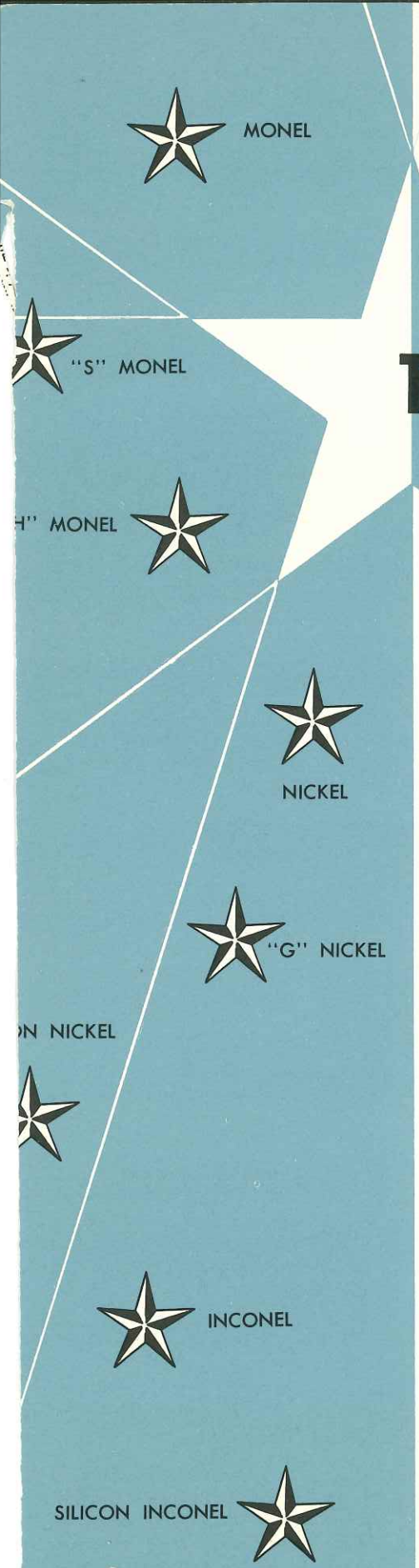
[2] MIL-N-20164 consists of a cover sheet (only) and supersedes Navy 46Mlg. While generally acceptable, the requirements for "Carbon and Silicon combined—2.0% max." in both QQ-C-551 and MIL-N-20164 are unrealistic and should be revised, in both specs., to call for "Carbon—0.35% max." and "Silicon—1.00/2.24%."

[3] MIL-N-20165 consists of a cover sheet (only) and supersedes Navy 46N7. The Yield Strength requirements for "Class A ("H" Monel)" are such that they cannot be met commercially. Do not use MIL-N-20165 for purchases of Class A ("H" Monel) but use instead MIL-N-4498(USAF) (Comp.I).

AVAILABLE LITERATURE

Additional engineering data on cast Inco Nickel Alloys is contained in a series of Inco Casting Data bulletins currently being prepared. The first two in this series, "Engineering Properties of "S" Monel" and "Engineering Properties of Cast Monel" are now available.

List "B" catalogs all publications on Inco Nickel Alloys including property and working instruction bulletins which contain information on our cast alloys. This literature is yours for the asking.



The Ninth Alloy.....

By the time this booklet is printed, it may be out of date.

Because here at the research laboratory of Inco's foundry, our casting specialists and metallurgists are constantly searching for new alloys to provide still longer service life under destructive conditions. We don't know yet which of our investigations will lead to this next alloy—The Ninth. Very possibly it will provide the combination of properties needed to solve your worst casting problem! For example:

As this page is being written, a new alloy, known only by the number, "803," is undergoing a series of tests. If these tests confirm our expectations, an entirely new set of corrosion-resistant properties will be available in cast form for the first time.

Another alloy is being developed that promises to completely change our concept of how hard a casting can be. Still another alloy in the development stage combines Nickel with certain unusual materials that may open up an entirely new series of Inco Nickel Alloys for special purposes.

Soon it may be possible to supply you with castings with certain superior properties which have heretofore been available only in wrought Inco Nickel Alloys.

Even our present casting alloys are under constant study to improve their properties and lower their costs:

One newly discovered technique already in experimental production may make possible undreamed of surface smoothness on sand castings. Another development promises to drastically reduce excess metal needed for the large sized castings.

A new process we are experimenting with hints that soon it will be possible to produce sand-type castings with surface and tolerances approaching those of precision castings—but at costs approaching those of sand castings!

Which Of These New Developments Will Produce The Ninth Alloy?

No one can be sure, yet. Perhaps it will be one which is still in the experimental stage. Or it may be one of those waiting only for the results of field testing before it is announced.

So, even if you don't see exactly what you are looking for in this booklet, there is a good chance we already have data on the problem that is troubling you. If it is a part that fails because of destructive service conditions—a small part whose costs seem out of line—a part that requires high maintenance—a part that doesn't do its job properly—it will pay you to look into Inco castings.

On the next page you will see how easy this is to do . . .

When It's A Question of CASTINGS . . .

. . . LET INCO'S CASTING SPECIALISTS HELP YOU FIND THE ANSWER

Whether you need advice on the selection of an alloy that will do your job or more information on Inco castings, Inco's casting specialists will be glad to help you. There is never any obligation for this service.

When, for example, you are confronted with a corrosion problem, our Corrosion Engineering Service will study it and suggest a practical solution. If, on the other hand, your trouble is caused by abrasion, erosion, galling, heavy loads or rigid product purity requirements, our Technical Service Section is ready to help you. And if the costs of some small part seem out of line, our precision casting specialists will study it and tell you whether or not it will pay you to have it precision cast.

The easiest way to take advantage of Inco's consulting service is to let us know your problem. Then let us do the rest.

Our castings specialists will examine your blueprint, analyze the service conditions and fabricating problems involved, and then suggest the most practical way out of your difficulty.

INCO TRADE MARK WHERE YOU CAN GET INCO CASTINGS and SERVICE INCO TRADE MARK

ATLANTA 3
J. M. Tull Metal & Supply Co.
285 Marietta Street
Tel. Alpine 3871

BALTIMORE 5
Whitehead Metal Products Company, Inc.
4300 East Monument Street
Tel. Eastern 7-3200

BUFFALO 7
Whitehead Metal Products Company, Inc.
2128 Elmwood Avenue
Tel. Bedford 3100

CAMBRIDGE 39, MASS.
Whitehead Metal Products Company, Inc.
281 Albany Street
Tel. Trowbridge 6-4680

CHICAGO 23
Steel Sales Corporation
3348 South Pulaski Road
Tel. Bishop 7-7700

CINCINNATI 29
Williams and Company, Inc.
3231 Fredonia Avenue
Tel. Capitol 3000

CLEVELAND 14
Williams and Company, Inc.
3700 Perkins Avenue
Tel. Utah 1-5000

COLUMBUS 8, OHIO
Williams and Company, Inc.
851 Williams Avenue
Tel. Klondike 1623

DALLAS 9
Metal Goods Corporation
6211 Cedar Springs Road
Tel. Elmhurst 3271

DENVER 2
Metal Goods Corporation
2425 Walnut Street
Tel. Acoma 2-5891

DETROIT 10
Steel Sales Corporation
5151 Wesson Avenue
Tel. Tyler 6-3000

EDMONTON, ALTA.
Wilkinson Company, Ltd.
7025 103rd Street
Tel. 35834

GRAND RAPIDS 2
Steel Sales Corporation
226 Federal Square Building
Tel. Grand Rapids 9-3981

HARRISON, N. J.
Whitehead Metal Products Company, Inc.
1000 South 4th Street
Tel. Humboldt 5-5900

HOUSTON 3
Metal Goods Corporation
711 Milby Street
Tel. Central 8881

INDIANAPOLIS 18
Steel Sales Corporation
2185 N. Sherman Drive
Tel. Cherry 1535

KANSAS CITY 8, MO.
Steel Sales Corporation
2201 Grand Avenue
Tel. Victor 7270

LOS ANGELES 21
Pacific Metals Company, Ltd.
1400 South Alameda Street
Tel. Prospect 0171

LOUISVILLE 3
Williams and Company, Inc.
1109 South Preston Street
Tel. Clay 7781

MILWAUKEE 9
Steel Sales Corporation
2400 West Cornell Street
Tel. Hilltop 2-2020

MINNEAPOLIS 13
Steel Sales Corporation
401 Harding Street, N. E.
Tel. Sterling 1-4838

MONTREAL 28, QUE.
Robert W. Bartram, Limited
2075 West Broadway Avenue
Tel. Hunter 8-2511

NEW HAVEN 13
Whitehead Metal Products Company, Inc.
265 Church Street
Tel. Spruce 7-2345

NEW ORLEANS 12
Metal Goods Corporation
432 Julia Street
Tel. Canal 7373

NEW YORK 14
Whitehead Metal Products Company, Inc.
303 West 10th Street
Tel. Watkins 4-1500

PHILADELPHIA 40
Whitehead Metal Products Company, Inc.
1955 Hunting Park Avenue
Tel. Baldwin 9-2323

PHOENIX
Pacific Metals Company, Ltd.
19 No. 4th Street
Tel. Alpine 40369

PITTSBURGH 33
Williams and Company, Inc.
901 Pennsylvania Avenue
Tel. Cedar 1-8600

PORTLAND 12, ORE.
Eagle Metals Company
2336 North Randolph Avenue
Tel. Tuxedo 5201

ST. LOUIS 10
Steel Sales Corporation
4565 McRee Avenue
Tel. Prospect 1-5255

SALT LAKE CITY 4
Pacific Metals Company, Ltd.
261 West 5th South
Tel. 22-3461

SAN DIEGO 1
Pacific Metals Company, Ltd.
1533 India Street
Tel. Belmont 4-3255

SAN FRANCISCO 10
Pacific Metals Company, Ltd.
3100 Nineteenth Street
Tel. Mission 7-1104

SEATTLE 4
Eagle Metals Company
4755 First Avenue South
Tel. Lander 9974

SPOKANE 24
Eagle Metals Company
Helena at Broadway
Tel. Keystone 0586

SYRACUSE 4
Whitehead Metal Products Company, Inc.
207 W. Taylor Street
Tel. 74-4641

TOLEDO 12
Williams and Company, Inc.
946 Kane Street
Tel. Klondike 8661

TORONTO 2, ONT.
Alloy Metal Sales Limited
181 Fleet Street East
Tel. Empire 3-9421

TULSA 3
Metal Goods Corporation
302 North Boston Street
Tel. Tulsa 4-4101

VANCOUVER, B. C.
Wilkinson Company, Ltd.
190 West Second Ave.
Tel. Emerald 2121

WINNIPEG, MAN.
Alloy Metal Sales Limited
20 Montcalm Street
Tel. 501141

THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall Street, New York 5, N. Y.

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